Reply to Comments on FCC 93-455: Notice of Proposed Rule Making

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1. Overview

Numerous comments have been filed in response to FCC 93-455: Notice of Proposed Rule Making. Clearly, many institutions have invested substantial resources, and many individuals have spent substantial time, in trying to help the FCC find the most appropriate way to allocate by auction the PCS licenses it intends to issue.

Unfortunately, there is no "perfect" way to conduct the auction. Any proposal must reflect some compromise between issues of economic theory and issues of practicability. In the various comments, the compromise has been made in many different ways, resulting in a number of strikingly-different proposals.

In this "reply to comments", I will attempt to summarize some of the most important issues that have been raised, to highlight the issues on which consensus seems to have emerged, and to point out some of the places where I believe the compromises have gone too far in one direction or the other.

This reply will refer, at times, to the paper attached to TDS's original comments. In the interest of brevity, detailed discussion presented therein will not be repeated here.

2. A compelling case has been presented against nationwide-only combinatorial bidding

The arguments presented in many of the filed comments together provide very strong reasons for *not* allowing nationwide-only combinatorial bidding. The arguments are of two types: Some specifically address problems associated with nationwide-only combinatorial bidding, and others more generally deal with reasons to not facilitate the acquisition of nationwide licenses.

The three primary arguments against nationwide-only combinatorial bidding are summarized below:

(a) Bidders for individual MTA licenses will face a strategic "free-rider" problem. Each must bid not only for a license, but also against prospective nationwide bids. The need to bid against nationwide bids is a burden shared by all bidders for individual licenses, and each faces the temptation to let others bear the lion's share of the burden. The result is a potential suppression of the total of the winning individual bids, and consequently the increased likelihood of a nationwide combinatorial bid winning even when individual bids might have, in the absence of combinatorial bidding, yielded a more efficient allocation of licenses. In addition, the lessened probability of winning an individual license can lead some smaller applicants to forgo expenditures for required research prior to

auction participation, and to abstain from the block-A and block-B auctions, despite the fact that they value some individual licenses more highly than the applicants which do choose to compete.

(b) Applicants seeking a substantial, but less-than-national, presence in the market will be forced to enter nationwide bids to protect their interests. Such an applicant, if it wins a nationwide license, will consequently acquire licenses which it does not desire, or which would be valued more highly (and developed more effectively) by other licensees. (Indeed, it is extraordinarily unlikely that any one applicant will value every MTA license in the nation more highly than any other applicant.) Therefore, the selling of a nationwide license will be likely to yield either inefficient development, or significant profits to the purchaser in the after-auction market.

(c) There is varying legal opinion concerning the propriety of accepting nationwide combinatorial bids. It is therefore likely that challenges will be filed against any procedure which includes nationwide combinatorial bidding. Whether the challenges are successful or not, the issuance of licenses and the beginning of service provision will inevitably be delayed.

In addition, a number of points have been raised against nationwide combinatorial bidding which actually constitute arguments against *allowing* any applicant to acquire nationwide coverage, whether through combinatorial bidding or some other process. These include the increased potential for noncompetitive or anticompetitive behavior, retardation of technological innovation, lessened incentives for the development of interoperability standards, lack of licensee focus on the needs of individual markets, lack of general diversity, and slower overall buildout.

In light of these additional points, it is recommended that the FCC give serious consideration to the adoption of overall population-coverage limits for any single licensee or consortium.

Surprisingly, those comments which include nationwide-only combinatorial bidding in their proposed procedures really fail to make any particularly-strong case supporting it. Therefore, it seems quite inappropriate for the FCC to cling to this idea.

3. There are severe problems inherent in all proposed auction rules (both no-combinatorial-bidding and full-combinatorial-bidding procedures) which call for the simultaneous ascending-bid sale of all MTA licenses

Once nationwide-only combinatorial bidding is eliminated from consideration, the proposals for PCS auctions fall neatly into three categories: sequential ascending-bid

auctions, simultaneous ascending-bid auctions with no combinatorial bidding, and simultaneous ascending-bid auctions allowing all possible combinations of licenses to be bid upon.

A. Simultaneous combination-free auctions are discussed in great detail in the Pacific Bell/Nevada Bell and PacTel comments. Several aspects of those comments warrant reply.

First and foremost, the proposed (by Pacific Bell/Nevada Bell) simultaneous ascending-bid auction will expose bidders to substantial amounts of strategic risk, and holds the potential for extremely-inefficient outcomes requiring substantial post-auction trading. Many of the likely auction participants will hold an interest in assembling regional packages of licenses covering several geographically-contiguous MTAs, typically centered around a "hub" MTA. (Of course, some might choose to seek packages covering a major transportation corridor, or to focus their efforts only on the acquisition of licenses covering non-contiguous major metropolitan areas.) Consider an applicant attempting to acquire a license covering a particular large MTA together with licenses on several smaller adjacent MTAs. At no point in the auction will this applicant ever hold the guarantee that it will obtain the large-MTA license. There will always be the possibility that, after days (or weeks, or months) of inactivity in bidding for this license, some other applicant, shifting its attention from some other region, will reopen the bidding for this particular license by raising the bid. Therefore, the current high bidder must remain reluctant to bid aggressively for the licenses on adjacent MTAs. This will have three effects: It will lessen the prices drawn by those other licenses. It will slow the progress of the auction. And it will lead, at times, to a final allocation very different from what an applicant desired, with the applicant winning a ring of licenses but losing the desired hub. (Such an allocation would likely be very unsuited to the services and technology that the applicant planned to offer.) Yet, since bids are non-withdrawable under this proposal, the applicant will not be able to free resources committed to the current high bids in order to seek a full regional package elsewhere.

Next, the estimate of auction time requirements (a few weeks?) is wildly optimistic. Imagine how the process might unfold. A number of larger applicants, each hoping to acquire one or more regional holdings with a large metropolitan hub, compete for the major metropolitan areas. Waiting to see how the competition develops across the larger MTAs, many of these bidders "lay back", bidding on only one or two licenses each day. In the meantime, since daily participation is required of all bidders, smaller applicants, not yet knowing how the market will develop, put in a single bid each day on a relatively-inexpensive license (not really hoping to win that license, but simply acting to remain eligible to bid seriously at some later point). Eventually (with only one round of bidding per day, perhaps after many weeks), the bids on the largest MTAs slow down, and activity picks up on MTAs contiguous to those which have already drawn substantial activity. Yet even here, since the bidding on the largest MTAs is not yet "closed",

bidders seeking to expand around a hub face the risk of a later bid topping theirs, and therefore suppress their bids somewhat (protecting against the risk of being "aced out"). Only after the MTA bidding has settled down do other bidders begin to compete seriously, choosing day-by-day which of the 2500-odd BTA licenses to bid for. In consequence, the auction (with the proposed single round of bidding each day) could easily stretch out far beyond a year.

Finally, in an attempt to deal with the potential for the proposed auction to drag on interminably, it is also proposed that bid increments have a substantial lower bound (e.g., 5% of the currently-high bid). Yet the higher one sets the minimum bid increment in an ascending-bid auction, the closer one comes to actually holding a sealed-bid auction, with all of its concomitant problems: reduced information revelation, greater exposure of bidders to the "Winner's Curse" (and consequently, reduced revenues to the seller), a greater need for bidders to estimate their competitors' bidding limits before they enter their own bids (i.e., more "game-playing"), and the like. (Of course, a sealed-bid auction is for all purposes equivalent to an ascending-bid auction with a sufficiently-large minimum bid increment: All bidders submit initial bids, the auctioneer recognizes the highest, and it wins since no-one can afford to make an increase.)

The PacTel proposal attempts to deal with some of the problems discussed above by selling each license as soon as the bidding stops *for that license*. This is a bit better in some ways, yet worse in others. Better, since delayed reopening can't occur, so the potential for grossly-inefficient license allocation is somewhat reduced. Worse, since more guessing is required from round to round.

Imagine an applicant seeking either of two licenses covering different areas, but lacking the resources to acquire both. Such an applicant must constantly worry that bidding on one will close, while that applicant is currently bidding on the other (which is currently available at a more attractive price). If the price in the still-active auction climbs too high, the applicant will not be allowed to reopen the bidding for the other license, even if the applicant would have been willing to pay substantially more than the price at which the bidding closed.

To avoid this situation, the PacTel proposal permits bid retraction at a modest penalty. But then the feedback loop becomes extraordinarily complicated, with cascading retractions (if the second-highest bidder also is overcommitted elsewhere). Furthermore, smaller applicants will be disadvantaged by their exposure to bid-withdrawal penalties (relative to larger applicants, which might not face the same underlying resource constraints, and therefore would rarely have to retract bids). An additional problem is that an applicant holding several winning bids, and wishing to retract one or more, holds the ability to choose which of the second-high bidders to "favor" with its retraction: The temptations for "deal-making" can be substantial (and can even ripple back into the final

rounds of the original auctions, as some bidders consider the value of "holding up" others by over-bidding, and then "negotiating" a retraction).

The PacTel proposal briefly discusses on-the-fly adjustment of minimum bid increments, with the goal of bringing all auctions to conclusion at roughly the same time. But if this is done, most of the efficiency gains this procedure might offer over the Pacific Bell/Nevada Bell proposal are lost.

In summary, both of the proposals discussed here are seriously flawed. Simultaneous ascending-bid auctions of individual items are indeed appropriate in some settings: One such setting is discussed later in this reply (for the sale of pairs of 30 MHz licenses covering the same MTA). But when some bidders face capital constraints, and others seek to acquire sets of items considered more valuable than the individual components, the problems associated with simultaneous ascending-bid auctions appear insurmountable.

B. A simultaneous ascending-bid auction, permitting bidding for all combinations of items, is proposed by NTIA. In an ideal world, this would be precisely the right procedure to use. Unfortunately, ...

The world we live in is one of bounded computing ability, which falls far short of what is required to make this proposed procedure work. Huge numbers of possible combination bids would have to be assessed (and reassessed as the bidding goes on) by bidders: Rough calculations show that, at a penny per possible combination, the U.S. national debt could be paid many times over. At the least, the resources needed for a bidder to monitor all interesting strategic opportunities would be substantial enough to disadvantage smaller potential competitors.

In addition, the free-rider problem which is present in nationwide-only combinatorial bidding is also present in all-combinations bidding, and to a much more substantial extent. To deal with this, NTIA proposes that bidders not only be allowed to bid on subsets, but also be allowed to "negotiate" with other bidders on joint bid increases needed to top a bid entered by some other bidder for a larger subset of licenses including those sought separately by the negotiating parties. This, of course, creates both another level of complexity to the auction process, and opportunities for abuses (such as playing off one negotiating partner against another, or proposing collusion ("I'll pick up the larger share of the bid increase here, if you'll agree not to bid on this other license ..."), or discriminating against some potential negotiating partners).

An issue *not* discussed in the NTIA proposal is bid withdrawal. If one applicant is the high bidder for some license, and another bidder is high for another, and a third bidder tops the sum of the two bids with a bid for both licenses, will the individual bids be canceled? If so, then the burden of negotiations (to pull together a set of separate bids to top the joint bid) is increased. If not, then each of the individual bidders must worry that

the other will later increase its bid enough to reactivate *both* individual bids; either individual bidders with overall resource constraints will therefore find themselves unable to shift their bidding activity elsewhere, or they must be given an opportunity to withdraw their bids (after which the next-highest individuals must also be given such an opportunity, and so on).

The idea behind this proposal is an attractive one. It is only the scale of the PCS auction which makes it intractable. In a later section of this reply, the use of a combinatorial bidding scheme on a smaller scale (for spectrum aggregation in the sale of BTA licenses) is advocated.

Section summary: None of the proposals discussed here are unreasonable, *in the proper setting*. Elements of each are present in the proposal filed by TDS in the "comments" round; that proposal will be summarized later in this reply. However, the simultaneous sale of licenses covering 51 MTAs is not a proper setting for the use of any of these proposed procedures. Therefore, **the sale of MTA licenses must be conducted in sequence.**

4. There is a general consensus that the sequential sale of MTA licenses should progress from the MTAs with the largest population to those with the smallest

The primary advantages of this order of sequencing are that it facilitates regional "hubbing", and that it brings substantial valuable information (concerning both pricing and licensee identity) into the public domain quickly. The information will help applicants bidding for licenses covering smaller MTAs, and for 20 or 10 MHz licenses at the BTA level, to refine their acquisition strategies, and hence will enhance the efficiency of the final allocation of licenses.

5. The simultaneous sale of both 30 MHz licenses covering an MTA is preferable to the sale of all licenses in one block before all licenses in the other

Selling both 30 MHz licenses covering a single MTA before moving on to another MTA will quickly clarify the regional hubbing situation. To only sell a single license before selling licenses on adjacent blocks will grant a substantial informational advantage to the winner of the single license (over other applicants who intend to compete for the second license covering the MTA, but don't yet know whether they will be successful).

Once it is decided to sell both licenses before moving on to another MTA, it remains to decide upon a method of sale. Selling the two licenses in sequence forces bidders to make strategic "guesses" which can reduce the efficiency of the final allocation, and

reduce revenues from the sale. Each bidder must decide in the first round whether to continue to compete, or to wait for the second round and hope to win at a more attractive price. If two bidders which value both licenses quite highly guess incorrectly and choose to wait, the second license could sell for a much higher price than the first, and the first could end up in the hands of an applicant which would extract less value from it than the losing second-round applicant; this inefficiency could only be resolved in the after-auction market, with profits to the license seller that went uncaptured by the government in the auction. (Or, if both choose to bid aggressively in the first round, an efficient allocation will result, but the first-round winner could end up paying a substantially higher price than the second-round winner, even if both valued the licenses equally.)

To simplify strategic (game-theoretic) issues, and increase the likelihood of an efficient allocation at prices which more-closely reflect the values of the licenses to the winners, the two licenses should be sold simultaneously. Either simultaneous ascending-bid auctions, or a hybrid single-ascending-bid auction, could be used. Details concerning these alternatives are discussed in the Appendix to this reply.

6. Many of the problems in proposals for the simultaneous sale of all MTA licenses are much less severe when the sale of all BTA licenses within an MTA is considered

When attention is restricted to BTA-level licenses within a single MTA, many of the problems discussed in section 3 disappear. With the A and B blocks already allocated, most applicants will know which regions hold greatest interest for them. While some aggregations of BTA licenses within an MTA will still be more attractive than others, a much smaller variety of logically "hubbed" packages will exist than at the national (MTA) level. Smaller numbers of bidders can be anticipated at each sale, and the numbers of licenses to be sold at once (if the C and D blocks are offered separately from the E, F, and G blocks) will be smaller than in a sale of all MTA licenses.

In the previously-filed TDS comments, a particular procedure was proposed: The simultaneous ascending-bid sale of all BTA licenses within a single MTA, with combinatorial bidding allowed for spectrum aggregation only. This procedure combines aspects of the Pacific Bell/Nevada Bell proposal and the NTIA proposal, permitting the FCC to gain experience and establish precedents on a somewhat smaller scale than the sale of all MTA licenses. Issues involving timing, bid withdrawal, and the like are discussed in the previous comments.

Two issues warrant repetition:

1. If the C and D blocks are to be offered to a restricted set of bidders, then they should be sold *before* the E, F, and G blocks are offered. Once again, the primary reasons are to obtain an efficient allocation of licenses at fair market

prices, while saving applicants from the need to play strategic guessing-games. ("I'll be allowed to bid for the block-C and block-D licenses. But the E, F, and G licenses are being sold first. Should I hold back, hoping to get a better deal when the C and D licenses are sold (and risk getting shut out), or should I bid aggressively now, and perhaps pay more than would have been necessary had I waited?") By selling blocks C and D first, the FCC ensures that the later sale of blocks E, F, and G will take place on a level playing field.

2. Aggregation of spectrum should be facilitated by the selected auction procedure. A number of the filed comments suggest that competition will be facilitated by aggregation of spectrum into greater-than-20 MHz blocks; some comments suggest that such aggregation is necessary for economic viability. One way of easing the task of spectrum aggregation is to permit combinatorial bidding within a BTA across spectrum blocks.

With regard to bidder designation for participation in the sale of block-C and block-D licenses, it seems appropriate that applicants permitted to bid on these licenses in any one BTA within an MTA should automatically be permitted to bid for licenses in all of the BTAs within that MTA. This will facilitate competition on an equal footing among all designated auction participants when the BTA-level licenses are offered, by providing all with the same opportunity to aggregate licenses covering contiguous BTAs. If diversity is also encouraged through the use of relaxed payment requirements (such as payment in installments), then bidding decisions will be simplified (and diversity further encouraged) by allowing qualifying bidders to elect the same payment procedures on all licenses in the block-C through block-G range in any single BTA.

7. Conclusion

It has been fascinating to see the concurrence of opinion on some issues (such as opposition to nationwide-only combinatorial bidding), and diversity of opinion on others (such as the contrast between simultaneous and sequential auction proposals) in the comments filed on FCC 93-455.

A reading of the various comments has expanded my own appreciation of the concerns of the many different types of institutions interested in the PCS license allocation process. However, after careful consideration of the various proposals, I find myself seeing no need to revise or amend the proposal made in the paper attached to the original TDS comments.

The original proposal has some of the flavor of several of the alternative proposals discussed above, and therefore offers the advantage of setting multiple precedents. Simultaneous ascending-bid auctions for the block-A and block-B licenses, in sequence beginning with the largest MTAs, followed by combinatorial bidding across spectrum on blocks C and D, and then on blocks E, F, and G, with simultaneous parallel auctions on an MTA-by-MTA basis, seem to provide a good and proper mix of theoretical advantages and practical implementability. Scheduling requirements are easily predictable (and therefore the FCC can pre-announce the date on which construction permits will be issued, allowing applicants to begin their planning while guaranteeing that none get a "head start" on actual development), and bidders are never confronted with an unmanageable overload of information. The ultimate goal, to provide a format for the efficient provision of personal communications services to the public, seems attainable.

Some closing remarks may be useful. Several of the filed comments suggest that experimentation with alternative procedures be carried out prior to the FCC's final decision. Personally, I consider it unlikely that small laboratory experiments can come anywhere close to capturing the richness of the marketplace in which the allocation of PCS licenses will take place; indeed, experiments which attempt to generalize from vast simplifications of the actual situation are likely to be quite misleading. And time is limited. The FCC should simply put together a procedure which it feels is appropriate, and go forward.

However, I have heard that there is some discussion of a public meeting to discuss issues involving PCS auctions. Such a meeting could be of great value. But to give it focus, I would recommend that the FCC tentatively decide upon the procedure it will use, and then call a meeting devoted solely to fine-tuning the chosen procedure. By limiting the agenda to small changes in the selected procedure, the FCC is likely to obtain much more useful commentary than if a general debate of "big" auction-design issues were allowed.

8. Author's biography

Robert J. Weber holds the position of Professor of Managerial Economics and Decision Sciences at the J.L. Kellogg Graduate School of Management, Northwestern University. Educated at Princeton (A.B.) and Cornell (M.S., Ph.D.), he was a faculty member of the Cowles Foundation for Research in Economics at Yale prior to joining the Kellogg faculty in 1979. His research generally concerns strategic aspects of economic competition, with primary focuses on auctions and electoral processes. He is the author of more than 40 research papers and has served as a consultant to a variety of private and public institutions. He has served on the editorial board of the *International Journal of Game Theory*, and wrote one of the chapters for the forthcoming *Handbook of Game Theory*.

On the academic side, Professor Weber is co-author of the seminal paper, "A Theory of Auctions and Competitive Bidding" (*Econometrica* 50, 1982), and has published several subsequent articles on the auctioning of multiple items. On the more practical side, in the mid-1980s Professor Weber served as the external consultant on auction theory on the project (sponsored by the Department of the Interior) which developed the methods used to schedule area-wide auctions of petroleum extraction leases on the U.S. outer continental shelf. In June of 1992, he organized (with representatives of the Federal Reserve Board and the Department of the Treasury) and gave the opening address at the public forum which led to the currently-ongoing experiment in the use of uniform-price auctions to place the Treasury's 2-year and 5-year debt issues.

9. Appendix I: Procedures for the simultaneous sale, with ascending bids, of block-A and block-B licenses covering a single MTA

Bid increments:

Even when the sale of only a single item is considered, several aspects of an ascending-bid auction must be specified. What is the minimum acceptable bid increment? What is the maximum acceptable increment? Will increments be chosen by the bidders, or sought by an auctioneer?

The choice of a minimum increment raises issues at both extremes. If the minimum increment is too small, the auction can consume an unacceptably long period of time. But as the minimum increment is increased, the auction becomes less like an open procedure, and more like a sealed-bid auction. Indeed, if the minimum increment is extremely large (e.g., greater than the largest value the item being sold is worth to any bidder), then the opening bid will never be increased: The auction becomes either a race amongst the bidders to be the first to have its bid acknowledged, or becomes an auction in which all bidders submit initial bids, and the highest bidder is immediately proclaimed the winner.

If the maximum increment is large (or if there is no upper bound on the size of the increment), then "freeze-out" bidding becomes possible: A bidder can offer a substantial increase, hoping that others will perceive this increase as signalling a determination to win at any price, and will therefore concede. (Of course, if the bidders will subsequently meet in other arenas, some might attempt to push the price higher, hoping not to win, but to exhaust the resources of a competitor, i.e., strategic "gaming" becomes an issue.) In conjunction with a moderately-large minimum increment (say, for instance, 5% of the current high bid), a large maximum increment also opens the possibility of a bidder trying to estimate the most that any other bidder would be willing to pay, and then entering a bid below that amount by a margin just a bit smaller than the minimum increment (say, 4.5% below the maximum anyone else would be willing to bid).

To avoid "gaming", to gain the full advantage of open (as opposed to sealed) bidding, and to still keep the auction moving at an acceptable pace, it is common to keep the choice of increments under the control of an auctioneer. (Of course, the auctioneer can be either human or electronic.)

Auction procedures:

When two licenses are being offered for sale at the same time, other aspects of the auction format must also be specified. Chief among them are the choice of a stopping rule, and (perhaps surprisingly) the choice of what, precisely, is being sold.

A. One alternative is to conduct two parallel-but-linked (simultaneous ascending-bid) auctions, each of which establishes an ascending sequence of prices for one of the objects being sold. Any bidder who is not currently the high bidder for either license is allowed to increase the bid on either license, and the auctioneer brings the auction to a close when no bidder wishes to increase either currently-high bid.

[This is the approach advocated in my November 10 comments, as well as in the Pacific Bell/Nevada Bell (Milgrom and Wilson) comments.]

B. Another alternative is to conduct parallel-and-unlinked auctions. Bidders are allowed to compete simultaneously in both auctions (i.e., the current high bidder for one license is permitted to increase the current high bid for the other license). The auctioneer closes one of the auctions when bidding activity in that auction ceases, and closes the other when activity ceases in that one, as well. If a bidder is the high bidder in both auctions, then that bidder is allowed to retract its bid for one of the licenses, leaving the second-highest bidder for that license as the winner (at the price bid by the second-highest bidder).

This alternative seems somewhat less attractive then the previous one, for reasons which were given in section 3: (1) Bidders must worry that one auction will close early (at a time when they find the current price in the other auction more attractive), and that later (when the price in the still-active auction increases) they will regret not having stayed in the now-closed auction. One can expect that, to avoid this possibility, most bidders will remain constantly active in both auctions. Yet even this gives them only partial protection: If one of the two licenses is of somewhat lower value than the other, the auction for that license might still close "too" early.) (2) At the end of the auctions, if one bidder holds the high bid for both licenses, that bidder can choose which of the two (potentially different) second-high bidders will become the other winner. The temptations for "deal-making" can be substantial (and can even ripple back into the final rounds of both auctions).

[This is the approach advocated in the PacTel (McAfee) comments.]

C. Finally, a very different approach is to conduct a pair of auctions in sequence. The first auction sells to *two* bidders the right to receive their less-preferred of the two licenses; a second auction between just those two sells the right to select which license each receives. (The two auctions can, of course, be viewed as a single auction, in which the high bidder receives the license it chooses, and the second-high bidder receives the remaining license. In this case, the natural pricing rule is to charge the high bidder the final established price — roughly the price at which the second-high bidder stopped competing — and to charge the second-high bidder the price at which the third-high bidder stopped competing.)

In general, this approach can impose a heavy strategic burden on the bidders. In the second stage, each bidder must guess whether the other has the same preference ordering for the two licenses, or the opposite ordering. (In the former case, second-stage victory holds positive value for each, but in the latter case, winning the second stage is of no value, since each bidder will eventually get its more-preferred license.) Furthermore, the decision concerning how far to compete in the first stage involves anticipating the cost — and likely result — of participation in the second stage. (For example, the decision of the currently-third-highest bidder in the first stage to compete further might depend on which of the two currently-higher bidders is expected to continue competing.)

These strategic complications are somewhat ameliorated if it is obvious to all bidders (i.e., if it is "common knowledge" among them) that one of the licenses holds higher value for all bidders than does the other license. Yet even in this case, temptations for deal-making between the final two bidders can be quite strong.

[This is the approach advocated in the Bell Atlantic (Nalebuff and Bulow) comments. They also propose that the auction be conducted electronically. An ascending "price clock" is used together with bidder "buttons", and a bidder is considered "active" as long as its button remains depressed. (This is what they call the "Japanese" method.) Practical issues needing to be resolved would include the speed at which the clock ascends, and procedures for dealing with "my finger slipped off the button by accident" objections that bidders might raise.]

Of these three alternatives, (A) seems to be the one which is strategically most "transparent", and is the one most likely to yield an efficient allocation of licenses.

Implementation:

A primary advantage to the use of a live auctioneer (who controls bid increments) is that increments of moderate size can be sought in early bidding, and of smaller size as the pool of still-active bidders thins out. In addition, on-the-fly reduction of sought increments ("No-one will go up a million? Then how about another $500,000?") is feasible (and accepted in common practice).

However, the leeway available to an auctioneer in a private auction house might not be available to an auctioneer representing a government agency. The former is undisputed master of the auction process; the latter is subject to protests of unfairness, and to judicial review.

Programming an equivalent level of control into an electronic bidding system would not be difficult. Under method (A), one plausible procedure would be to set a fixed bid increment, and elicit bids at that increment. In each subsequent round (which need take no more than a minute or two), seek increases (at the fixed increment) to the currently-

high bids. If no increases are offered for either license, halve the sought-for bid increment and re-seek bid increases. When the sought-for bid increment is eventually decreased to some prespecified amount, and a round passes with no bid increases offered for either license, declare the auction closed. (With only 10 inactive rounds — interspersed, of course, by rounds with bid increases — the sought-for increment would be reduced by a factor of more than 1000.)

While strategic considerations are simple enough to require no more than one or two minutes between bid-submission rounds, the short inter-round delay is probably preferable to the use of a continuously-ascending price clock: It will give bidders a brief interval in which to reflect upon the relative prices of the two licenses, the size of the sought-for bid increment, and the identities of the current high bidders, before deciding whether and where to bid in the next round. Yet, at a very leisurely pace (say, one MTA auction every two hours, four auctions per day), all MTA licenses could be allocated in less than three weeks.

10. Appendix II: Reply to replies

Due to the postponement of the filing deadline, I've had the opportunity to read through drafts of the reply comments written by Barry Nalebuff and Jeremy Bulow for Bell Atlantic and by Preston McAfee for PacTel (and I've sent a draft of my reply comments to them). Since the common goal is to provide as much information as possible to the FCC before the final choice of auction methodology must be made, it seems desirable to include here a few replies-to-replies; in order not to abuse the sharing of replies, I've chosen to segregate all replies-to-replies in this appendix, rather than to revise my primary (circulated) reply.

The sequencing of auctions of pairs of 30 MHz MTA licenses on the first few days

A very specific proposal concerning the first four days of sales would be to offer the licenses covering Guam and American Samoa on day 1, followed by those covering Hawaii and New York on day 2, Puerto Rico and Los Angeles on day 3, and Alaska and Chicago on day 4. The pace of the auctions (i.e., the number of MTAs for which licenses will be sold) could be increased on subsequent days, as 30 MHz licenses are offered for the other MTAs in descending order of population coverage.

This would allow a bit more time for bidders to become familiar with the auction rules, and to assimilate information revealed from the first few sales. The licenses on the MTAs outside of the contiguous 48 states are natural ones to begin with, since regional hubbing is not an issue. (This idea arose during discussions with Barry Nalebuff.)

The advantage (offered by sequential sales) of predictable "closing" order

The most valuable information that can be provided to bidders, in order to enhance the efficiency of the final allocation of licenses by facilitating the early refinement of acquisition strategies, concerns the prices and identities of winning bidders for the 30 MHz licenses covering the largest MTAs. None of the proposed simultaneous-auction procedures can guarantee that this information will be available to bidders before they must commit themselves to the submission of potentially-winning bids on all other licenses; hence, the final results of simultaneous sales are likely to be much less efficient (and therefore are likely to generate lower auction prices and to require more after-auction adjustment) than the final results of sequential auctions.

The "robustness" advantage

This past summer, I circulated a paper which discussed simultaneous ascending-bid auctions in some detail. Even at that time (i.e., before the notice of proposed rule making was released), the suggested use of such auctions was restricted to the sale of modest numbers of licenses covering regions consisting of a small number of contiguous areas

(with the regions sequenced in descending order according to population coverage). The primary reason for the restriction was that I couldn't see any way to resolve problems involving coordination of bids across regions, non-informative closing orders, informational overload, and the like. After reading the filed comments proposing large-scale simultaneous ascending-bid auctions, I still see no solution to these problems.

Certainly, such large-scale simultaneous auctions have never been held before. Problems (in bid transmission and processing, or bid withdrawals, or bidder exclusion due to a filing-of-bids failure in a single day, or informational feedback to bidders, or other situations difficult to anticipate in advance) could lead to a catastrophic collapse in the bidding process after weeks of bidding activity. The FCC cannot afford to risk such a collapse, when simple (and much more robust) sequential procedures are available and are likely to yield outcomes at least as efficient as simultaneous procedures could.

Of course, the use of simultaneous auctions to sell pairs of 30 MHz MTA licenses involves little risk, since no bidder will be permitted to be active in more than one of the auctions at any instant.

The proposed use of simultaneous auctions for the sale of BTA licenses within a single MTA also involves little risk (a single "collapse" would cost less than a day, and would affect only a limited market, and could hence be viewed more as a "learning experience" than as an unmitigated disaster). This proposal is, of course, a compromise, intended to speed the auction process after the 30 MHz license auctions have brought substantial information into the public domain.

Bid withdrawal

Any time capital constraints and/or geographic synergies are present, simultaneous sales across MTAs or BTAs will potentially confront bidders with the desire to withdraw bids. But the logistical and strategic problems present in bid withdrawal are substantial. In the original TDS comments, it was proposed to allow bid withdrawals only in the simplest possible setting — when combinatorial bidding across spectrum is allowed during the sale of small numbers of BTA licenses. However, if withdrawals are definitely not to be a part of the finally-adopted procedure, then it is simple to eliminate combinatorial bidding across spectrum from the original TDS proposal, and use simultaneous ascending-bid auctions (as presented in both the TDS and the Pacific Bell/Nevada Bell comments) for small groups of BTA licenses.

"Small" groups is intended here to mean no more than 20 or 30 licenses at a time. Each sale could involve either the offering of block-C and block-D licenses, or blocks-E-through-G licenses, on about 10 BTAs (say, all the BTAs within a single MTA), or the block-C-through-G licenses on about 5 BTAs. (While I have reasoned previously that licenses on blocks C and D should not be offered *after* licenses on blocks E through G,

that reasoning does not preclude simultaneous offerings.) A critical tradeoff is between the desire to complete the sale of all licenses expeditiously, and the desire to avoid exposing the bidders to overwhelmingly-complex strategic considerations. By focusing any one offering on BTAs in the same area, it will be feasible to conduct the simultaneous ascending-bid auctions in "real" time; two sales per day for approximately 50 days (covering a total of roughly 2500 licenses) seems manageable.

Miscellany

While the PacTel (McAfee) reply in general is quite complimentary of the original TDS comments, one misstatement must be pointed out: The PacTel discussion of the proposed timing of the sequential sale of MTA licenses inaccurately mixes together separate aspects of the TDS proposals for MTA-level and BTA-level auctions.

Communities Served by TDS TELECOM (As of 10/31/93)

Central Region

Mid-Central Division	Access Lines	Communities Served
Arcadia Tel. Co. (OH)	718	Arcadia
Chatham Tel. Co. (MI)	2,531	Au Train, Chatham, Sand River, Skandia, Trenary
CCI (IN)	8,432	Clayton, Fillmore, New Ross, Roachdale, Whitestown, Wickliffe, Bainbridge
CCM (MI)	3,803	Augusta, Clayton, Hickory Corners
CCSI (IN)	1,819	Elnora, Poseyville, Wadesville
Continental Tel. Co. (OH)	2,081	Continental, Grover Hill, Miller City
Home Tel. - Pittsboro (IN)	1,759	Pittsboro
Home Tel. - Waldron (IN)	2,001	Waldron, Blue Ridge, Geneva, St. Paul
Island Tel. Co. (MI)	869	Bois Blanc, Beaver Island
Little Miami Comm. Corp. (OH)	2,207	Butlerville, Fayetteville
Oakwood Tel. Co. (OH)	1,073	Oakwood
Shiawassee Tel. Co. (MI)	4,625	Bell Oak, Perry, Shaftsburg, Morrice
Wolverine Tel. Co. (MI)	8,016	Fostoria, Millington, Munger, Sanford

Attachment C

Communities Served by TDS TELECOM (As of 10/31/93)

Central Region Continued

Mid-West Division	Access Lines	Communities Served
Badger Telecom, Inc. (WI)	5,962	Chili, Granton, Greenwood, Neillsville, Willard
Black Earth Tel. Co. (WI)	1,252	Black Earth
Bonduel Tel. Co. (WI)	1,621	Bonduel, Navarino, Zachow
BB&W Tel. Co. (WI)	3,128	Bohners Lake, Wheatland
Central State Tel. Co. (WI)	8,516	Auburndale, Junction City, Necedah, Pittsville, Vesper, Lindsey
Danube Tel. Co. (MN)	444	Danube
Eastcoast Telecom, Inc. (WI)	5,410	Cleveland, Collins, Howards Grove, St. Nazianz, Valders, Meene, Osman, School Hill, Spring Valley, Ada, Cato, Clarks Mills, Edwards, Franklin, Haven
Grantland Telecom, Inc. (WI)	3,573	Bagley, Bloomington, Fennimore, Mt. Hope, Woodman
KMP Tel. Co. (MN)	1,525	Kerkhoven, Murdock, Pennock
Mid-State Tel. Co. (MN)	6,267	Brooten, Howick, New London - MN, Sedan, Spicer, Sunburg, Terrace
Midway Tel. Co. (WI)	7,068	Dorchester, Medford, Perkinstown, Stetsonville
Mt. Vernon Tel. Co. (WI)	6,936	Mr. Vernon, New Glarus, Verona
Riverside Telecom, Inc. (WI)	2,592	Johnson Creek -(incl. - Grellton, Helenville & Farmington), Reeseville, Lowell
Scandinavia Tel. Co. (WI)	2,290	Iola, Scandinavia
S&S Tel. Co.(WI)	2,588	Forest Junction, Sherwood, Stockbridge, Tisch Mills
Tenney Tel. Co. (WI)	929	Alma
Waunakee Tel. Co. (WI)	5,056	Waunakee, Dane

Communities Served by TDS TELECOM (As of 10/31/93)

Central Region Continued

Western Division	Access Lines	Communities Served
Arizona Tel. Co. (AZ)	2,784	Blue Ridge, Greenehaven, Harquahala, Hyder, Marble Canyon, Morman Lake, Roosevelt, Sasabe, Supai, Tonto Basin
Asotin Tel. Co. (WA)	1,130	Anatone, Asotin, Flora-Troy
Cleveland County Tel. Co. (AR)	2,791	Kingsland, Rison, Rowell
Decatur Tel. Co. (AR)	1,141	Decatur
Delta County Tele-Comm (CO)	7,184	Cedaredge, Crawford, Eckert, Hotchkiss, Paonia, Somerset, Bowie, Lazear, Orchard City, Cory, Austin, Maher
Happy Valley Tel. Co. (CA)	2,957	Igo, Minersville, Olinda, Platina, Trinity Center
Home Tel. Co. - Condon (OR)	619	Condon
Hornitos Tel. Co. (CA)	542	Catheys Valley, Exchequer, Hornitos, Mt. Bullion
Lake Livingston Tel. Co. (TX)	1,062	Memorial Point
Mid-America Tel. Co. (OK)	1,534	Bromide, Fittstown, Hennepin, Stonewall
New London Tel. Co. (MO)	838	New London
OCSI, Inc (OK)	15,016	Adair, Choctaw, Cyril, Elgin, Fletcher, Gracemont, Inola, Jones, Kellyville, Mounds, Union City, Verden
Orchard Farm Tel. Co. (MO)	588	Orchard Farm
Potlatch Tel. Co. (ID)	916	Juliaetta, Kendrick
Stoutland Tel. Co. (MO)	1,095	Eldridge, Stoutland
Strasburg Tel. Co. (CO)	940	Strasburg
Troy Tel. Co. (ID)	779	Troy
Winterhaven Tel. Co. (CA)	1,257	Winterhaven, Felicity, Bard
Wyandotte Tel. Co. (OK)	560	Wyandotte

Communities Served by TDS TELECOM (As of 10/31/93)

Southeast Region	Access Lines	Communities Served
Amelia Tel. Co. (VA)	3,863	Amelia Court House, Jetersville
Barnardsville Tel. Co. (NC)	1,076	Barnardsville
Blue Ridge Tel. Co. (KY)	7,491	Blue Ridge, Dial, Lakewood, Mineral Bluff, Morganton
Butler Tel. Co. (AL)	4,352	Butler, Lisman, Needham, Pennington
Camden Tel. Co. (GA)	14,926	St. Mary's, Kingsland, Woodbine, Kings Bay
Calhoun City Tel. Co. (MS)	3,497	Calhoun City, Slate Springs, Vardaman
Concord Tel. Co. (TN)	14,545	Concord, Farragut
Goshen Tel. Co. (AL)	742	Goshen
Grove Hill Tel. Co. (AL)	2,007	Grove Hill
Humphreys County Tel. (TN)	1,440	New Johnsonville
Leslie County Tel. Co. (KY)	7,065	Bledsoe, Buckhorn, Canoe, Dwarf, Hyden, Stinnett, Wooten
Lewisport Tel. Co. (KY)	1,135	Lewisport
McClellanville Tel. Co. (SC)	1,339	Awendaw, McClellanville
New Castle Tel. Co. (VA)	1,816	New Castle, Paint Bank
Norway Tel. Co. (SC)	645	Norway
Oakman Tel. Co. (AL)	2,248	Flatwood, Lynn, Nauvoo, Oakman
Peoples Tel. Co. (AL)	12,452	Aroney, Cedar Bluff, Centre, Collinsville, Crossville, Gaylesville, Grayson, Leesburg, Rinehart, Sandrock, Whorton
Quincy Tel. Co. (FL)	11,596	Attapulgas (GA), Greensboro, Gretna, Quincy
Salem Tel. Co. (KY)	1,813	Salem
Saluda Mt. Tel. Co. (NC)	1,382	Saluda
Service Tel. Co. (NC)	1,033	Fair Bluff
SE Mississippi Tel. Co. (MS)	2,997	Leakesville, Neely, Sandhill, State Line
St. Stephen Tel. Co. (SC)	4,215	Bonneau, Pineville, St. Stephen
Tellico Tel. Co. (TN)	6,386	Ball Play, Coker Creek, Englewood, Niota, Riceville, Tellico Plains, Vonore
Tennessee Tel. Co. (TN)	43,769	Bruceton, Clifton, Collinwood, Cornersville, Darden, Decaturville, Halls Cross Roads, LaVergne, Mt. Juliet, Parsons, Sardis, Scotts Hill, Waynesboro, Hollow Rock
Virginia Tel. Co. (VA)	1,911	Hot Springs, Warm Springs, Healing Springs
Williston Tel. Co. (SC)	4,258	North, Williston

Communities Served by TDS TELECOM (As of 10/31/93)

Northeast Region	Access Lines	Communities Served
Chichester Tel. Co. (NH)	1,290	Chichester
Edwards Tel. Co. (NY)	1,912	Edwards, Hermon, Dekalb
Hartland & St. Albans (ME)	3,095	Harmony, Hartland, West Ripley
Kearsarge Telephone Co. (NH)	5,669	Andover, Boscawen, New London, Salisbury
Ludlow Telephone Co. (VT)	4,008	Ludlow, Proctorsville, Cavendish
M & M Telephone Co. (PA)	3,644	Mandata, Trevorton
Meriden Telephone Co. (NH)	471	Meriden
Northfield Telephone Co. (VT)	2,960	Northfield, Roxbury
Oriskany Falls Tel. Co. (NY)	727	Oriskany Falls
Perkinsville tel. Co. (VT)	810	Weathersfield, Baltimore
Port Byron Tel. Co. (NY)	3,101	Port Byron, Savannah
Somerset Tel. Co. (ME)	10,285	Athens, Bigelow, Carrabassett, Corburn Gore, Embden Lake, Kingfield, Mercer, New Vineyard, Norridgewock, North Anson, North New Portland, Phillips, Rome, Salem, Smithfield, Solon, Stratton, Strong, Weld
Sugar Valley Tel. Co. (PA)	1,001	Loganton
The Island Tel. Co. (ME)	578	Frenchboro, Isle Au Haut, Minturn, Atlantic, Matinicus, Swans Island
Warren Tel. Co. (ME)	1,614	Warren
West Penobscot (ME)	1,995	Corinna, Exeter, Stetson

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Attachment D

(Bank's Letterhead)

DRAFT

IRREVOCABLE STANDBY LETTER OF CREDIT NO. XXXXXX

ISSUED IN: Chicago, Illinois

APPLICANT: (name, address)

BENEFICIARY: Federal Communications Commission

$_____ (USD)

DATE OF INCEPTION: XX/XX/XX
DATE OF EXPIRY: XX/XX/XX
at issuing bank's counters.

CREDIT AVAILABLE WITH:
the Issuing Bank.

BY: PAYMENT

AVAILABLE BY DRAFTS AT SIGHT DRAWN ON:
XYZ Bank
Chicago, Illinois

THIS IRREVOCABLE STANDBY LETTER OF CREDIT NUMBER _____ is for the sole purpose of satisfying Section 309 (j) (8) of the Communications Act of 1934, as amended (47 U.S.C. 309 (j) (8)), which requires that all proceeds from the use of a competitive bidding system under the subsection referenced above, be deposited with the Department of Treasury, in accordance with Chapter 33 of Title 31, U.S. Code.

The funds under this IRREVOCABLE STANDBY LETTER OF CREDIT will be made immediately available upon presentment of this original IRREVOCABLE STANDBY LETTER OF CREDIT, and other documents referenced herein, and are segregated and set aside exclusively for the payment to the Beneficiary for the award(s) of licenses or permits issued by the Federal Communications Commission for the use of the electromagnetic spectrum by ABC Corporation (the "Applicant"), obtained through the competitive bidding process as stipulated under Section 309 of the Communications Act of 1934, as amended.

XYZ Bank of Chicago, Illinois (the "Issuing Bank"), hereby establishes this IRREVOCABLE STANDBY LETTER OF CREDIT NUMBER XXXXXXX in favor of the Beneficiary at the request of and for the account of the Applicant, for a maximum amount of $_____ (USD).

This IRREVOCABLE STANDBY LETTER OF CREDIT is available until the expiry date hereof against your draft(s) drawn at sight on XYZ Bank, Chicago, Illinois, ATTN: International Department and marked "Drawn under XYZ Bank's IRREVOCABLE STANDBY LETTER OF CREDIT NUMBER XXXXXX" and accompanied by the following documents:

Beneficiary's Letter, purportedly signed by an authorized representative of the Beneficiary, in form and substance to Exhibit A attached hereto and made a part hereof, drafted on the Beneficiary's letterhead.

This original IRREVOCABLE STANDBY LETTER OF CREDIT, along with the other documents referenced herein, must be presented at the office of XYZ Bank not later than the close of business of the expiry date, hereof.

The Issuing Bank undertakes that draft(s) drawn and presented in conformity with the terms of this credit will be duly honored.

PARTIAL DRAWINGS WILL BE PERMITTED.

THIS CREDIT IS SUBJECT TO THE UNIFORM CUSTOMS AND PRACTICE FOR DOCUMENT CREDITS, 1983 REVISION, INTERNATIONAL CHAMBER OF COMMERCE PUBLICATION 400. THE NUMBER OF THE CREDIT AND THE NAME OF THE ISSUING BANK MUST BE QUOTED ON ALL DRAFTS REQUIRED.

XYZ BANK

BY: _____